Advancements in Luminescence Thermometry Utilizing co-dopants Interactions

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Luminescent thermometers provide numerous continuously extending methods for absolute temperature determination. Mostly, temperature-dependent changes in the intensity ratio of emission bands, the emission kinetics, the emission band/line width, or the luminescence band/line peak position are utilized.

In our project, we selected aluminate materials, at first $SrAl_{12}O_{19}$ and $Y_3Al_5O_{12}$, substituted with Cr^{3+}/Eu^{2+} and Tb^{3+}/Pr^{3+}, respectively, to explore their potential for luminescent thermometers exploiting the aforementioned methods. The functionalization of phosphors via co-dopant interactions is a promising approach to managing properties useful for thermometric purposes. Co-doping entails launching complex, manageable interactions to tailor the material's luminescent behavior. By elucidating the intricacies of co-dopant interactions, this research promotes the rational design and optimization of functionalized phosphors for luminescent thermometry applications.

In the $SrAl_{12}O_{19}$ host, the mechanism of energy transfer between specific activators, Cr^{3+} and Eu^{2+}, will be tracked to develop the material's superior thermometric properties in a wide range of temperatures, from cryogenic to around 500 K, maintaining high accuracy and sensitivity of measurements. The co-existence of two dopants in the thick single crystal substrate of YAG:Tb garnet and a thin single crystalline film of YAG:Pr grown using the LPE method on it also appeared as a great tool to shape and improve luminescence thermometry purposes [1]. The possibility to efficiently excite, individually or simultaneously, the Tb^{3+} and Pr^{3+} dopants by their intense $4f \rightarrow 5d$ allowed transitions is executed to reach relative thermal sensitivity values higher than 1% K^{-1} over the range of temperatures as wide as 100–625 K. This research validates that using intra- and inter-configurational transitions of lanthanides allows designing wide-range accurate luminescence thermometers.

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